(12) UK Patent Application (19) GB (11) 2 399 719 (13) A

(43) Date of A Publication 22.09.2004

(21) Application No: 0306184.3

(22) Date of Filing: 18.03.2003

(71) Applicant(s):
Nokia Corporation
(Incorporated in Finland)
Keilalahdentie 4, FIN-02150 Espoo, Finland

(72) Inventor(s):
Janne Aaltonen

(74) Agent and/or Address for Service:
Venner Shipley LLP
20 Little Britain, LONDON, EC1A 7DH,
United Kingdom

(51) INT CL[7]:
H04L 1/06 1/00

(52) UK CL (Edition W):
H4P PEE PEP

(56) Documents Cited:
EP 0999669 A1 **WO 2002/043314 A1**
WO 2001/065760 A1 **WO 2000/076113 A1**
US 6484287 B1

(58) Field of Search:
INT CL[7] **H04L**
Other: **ONLINE : EPODOC, WPI, JAPIO**

(54) Abstract Title: **Transmission of data with forward error correction information**

(57) A method of transmitting content data to one or more receiving devices (5a, 5b) over a first communication channel (7) and transmitting recovery information associated with the content data over a second communication channel (9). The recovery information may be transmitted as a response to a request from the receiving device.

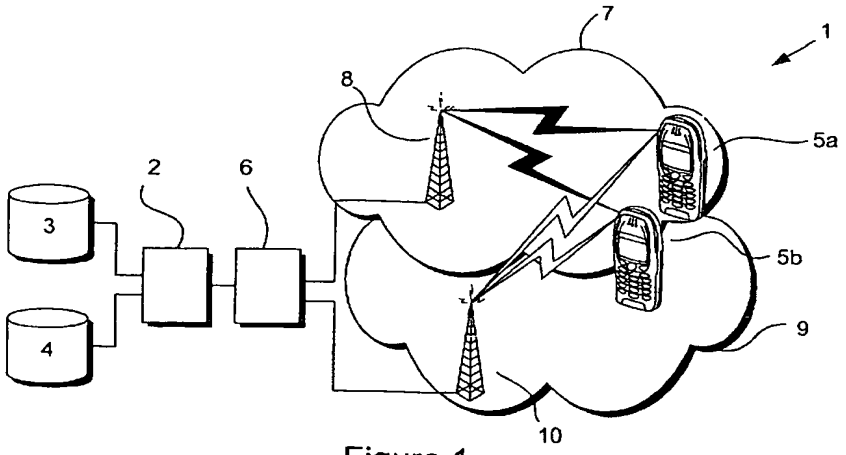

Figure 1

GB 2 399 719 A

Original Printed on Recycled Paper

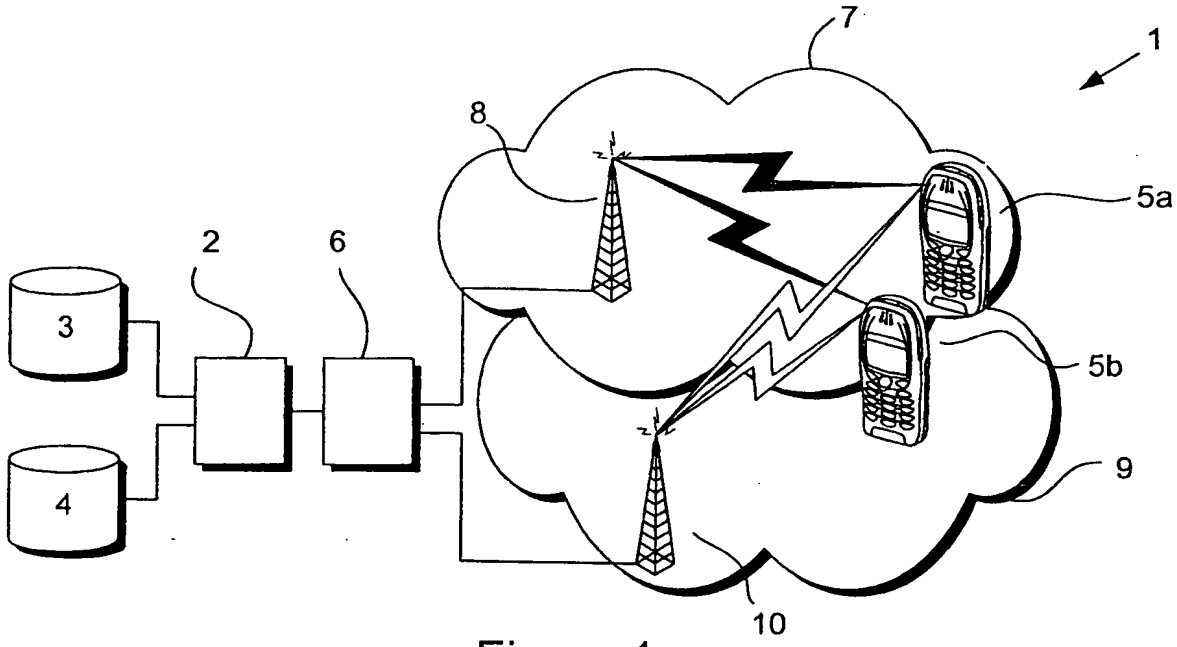

Figure 1

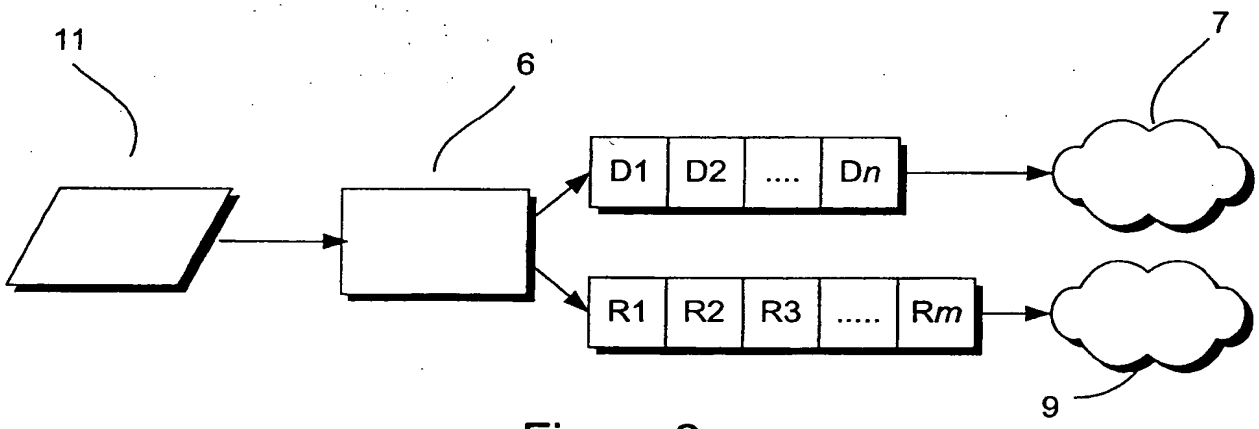

Figure 2

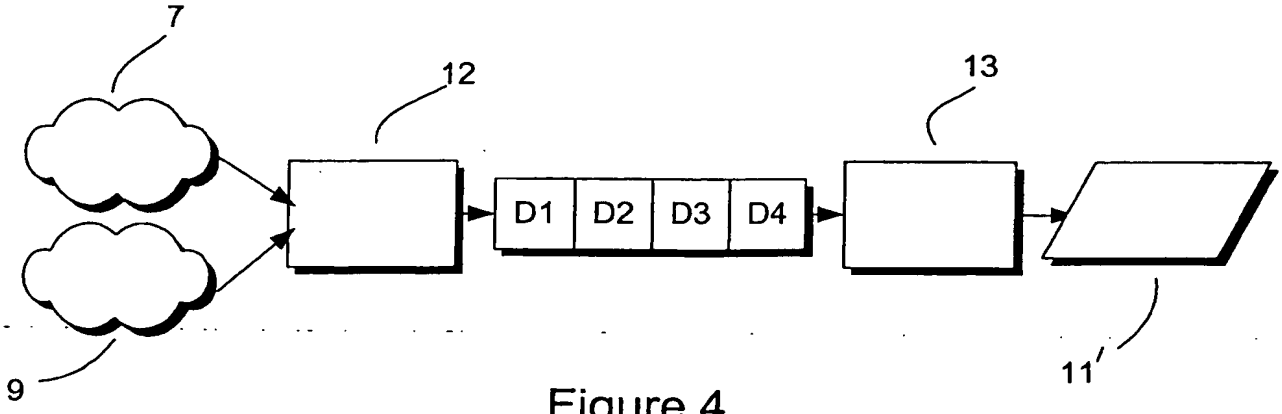

Figure 4

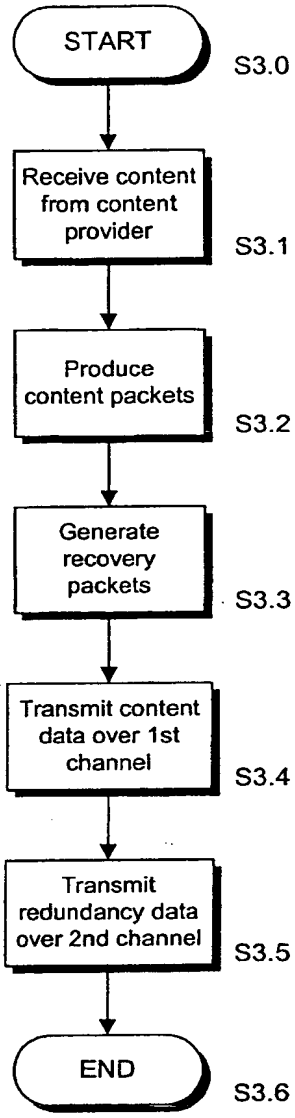

Figure 3

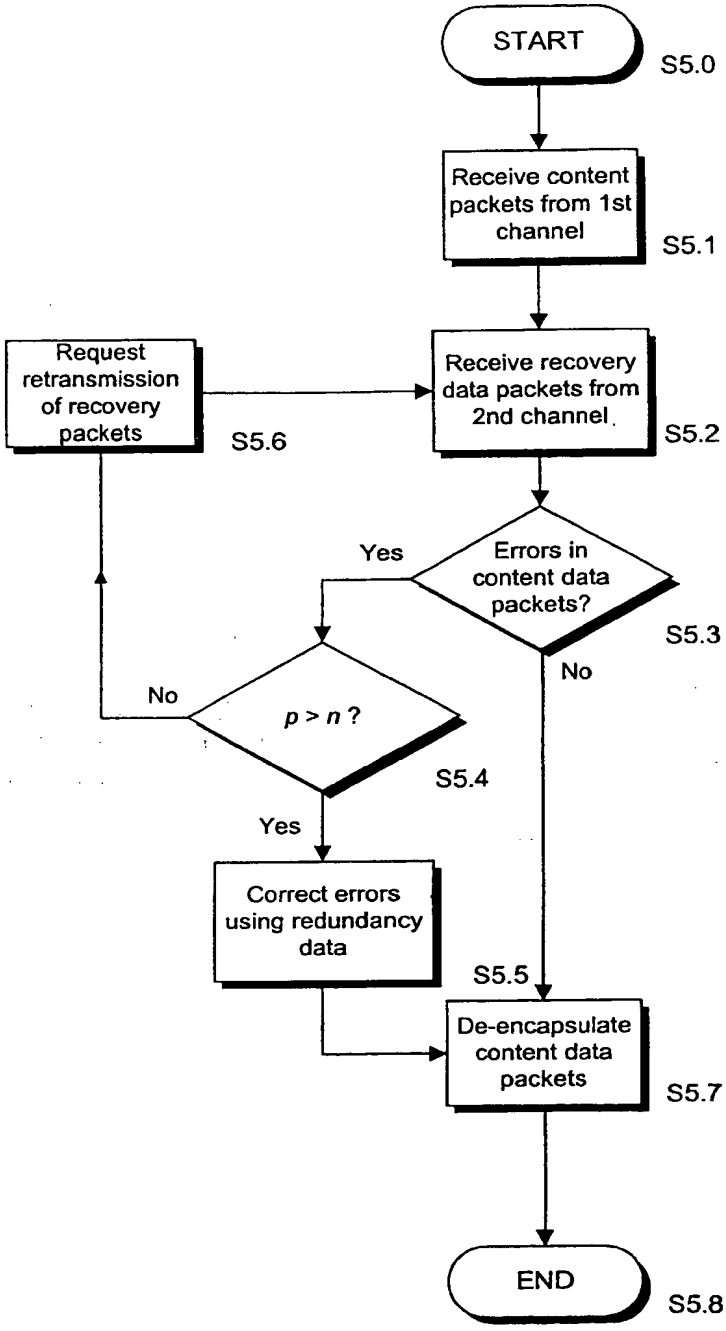

Figure 5

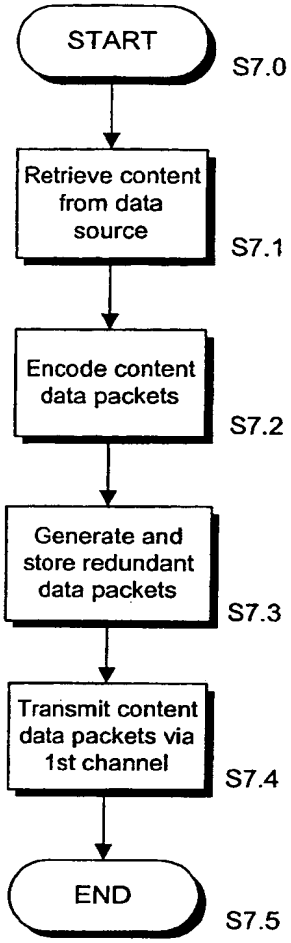

Figure 7

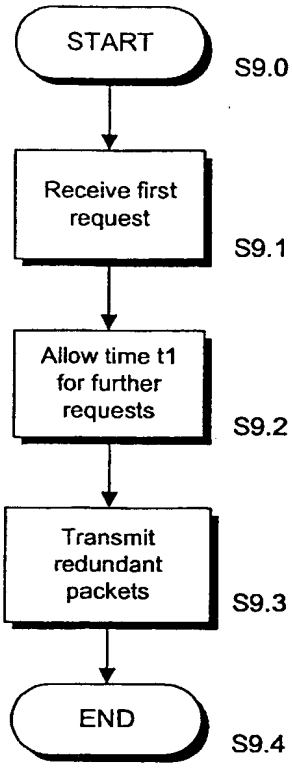

Figure 9

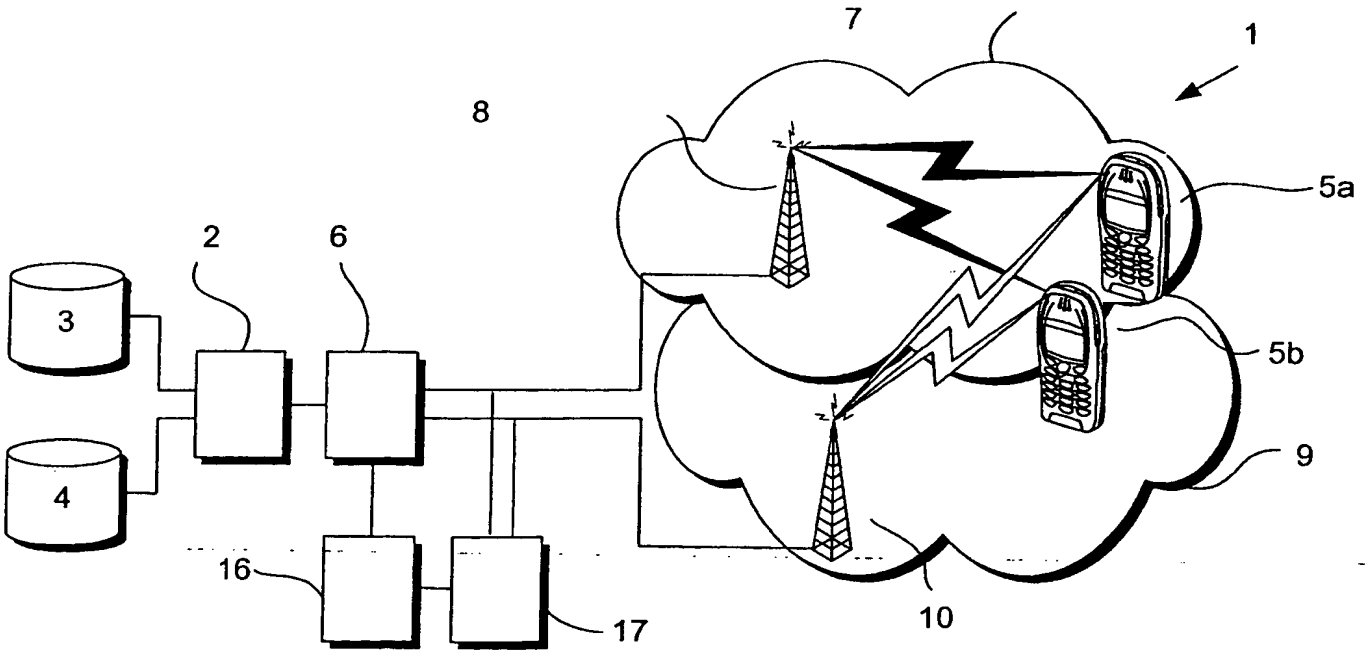

Figure 6

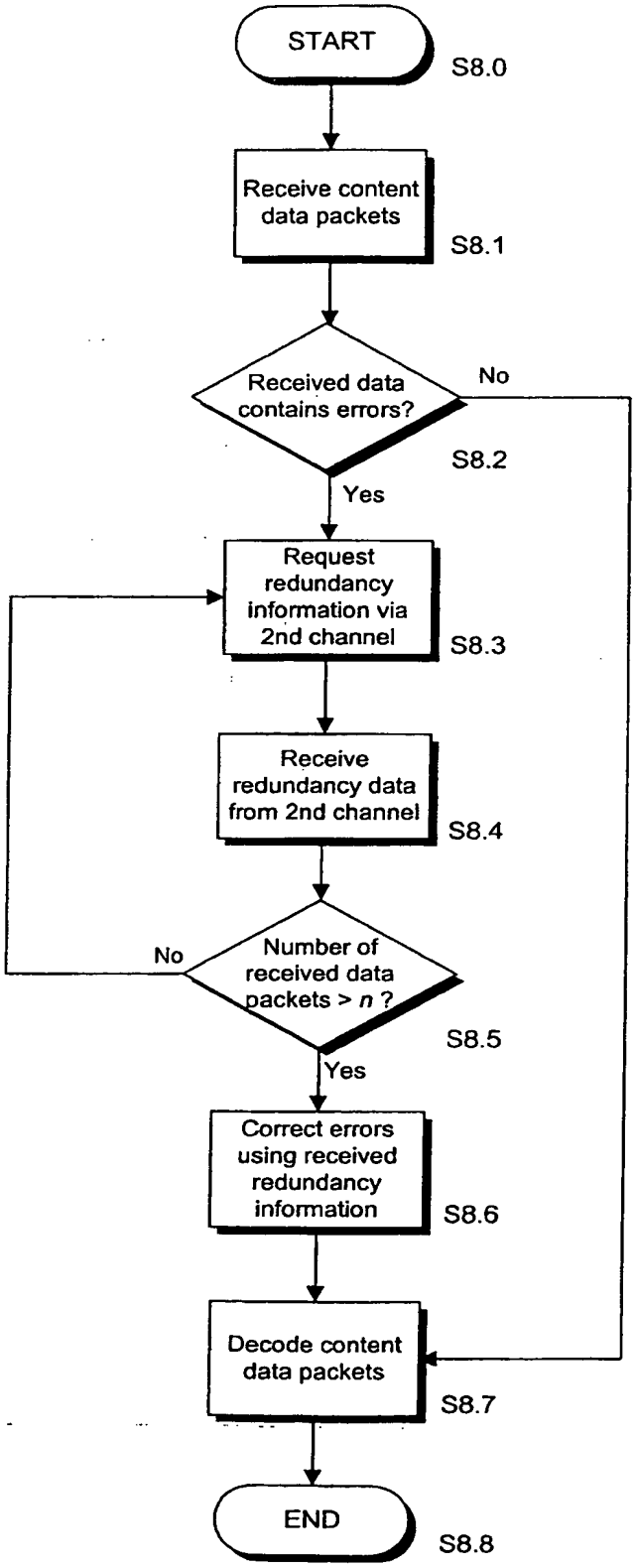
START
S8.0
Receive content data packets
S8.1
Received data contains errors?
No
S8.2
Yes
Request redundancy information via 2nd channel
S8.3
Receive redundancy data from 2nd channel
S8.4
No
Number of received data packets > n ?
S8.5
Yes
Correct errors using received redundancy information
S8.6
Decode content data packets
S8.7
END
S8.8

Figure 8

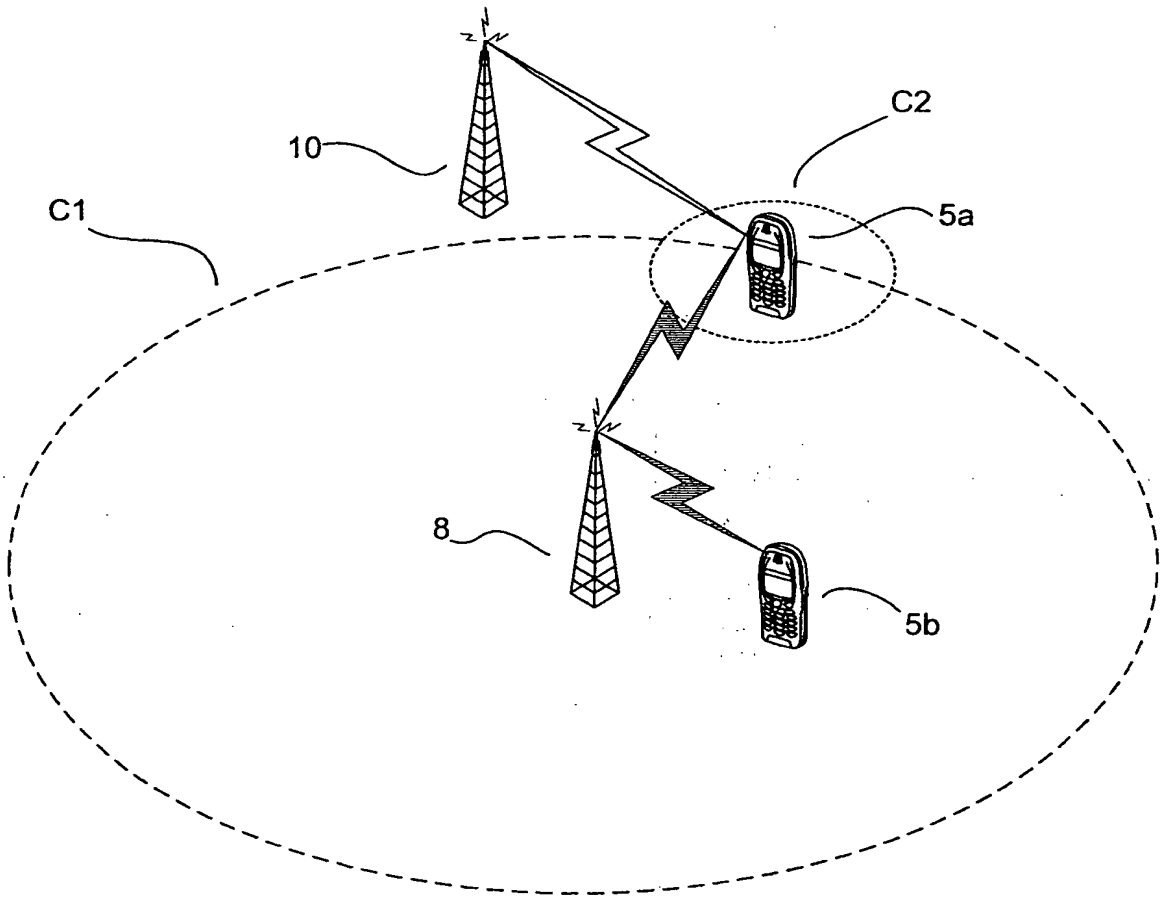

Figure 10

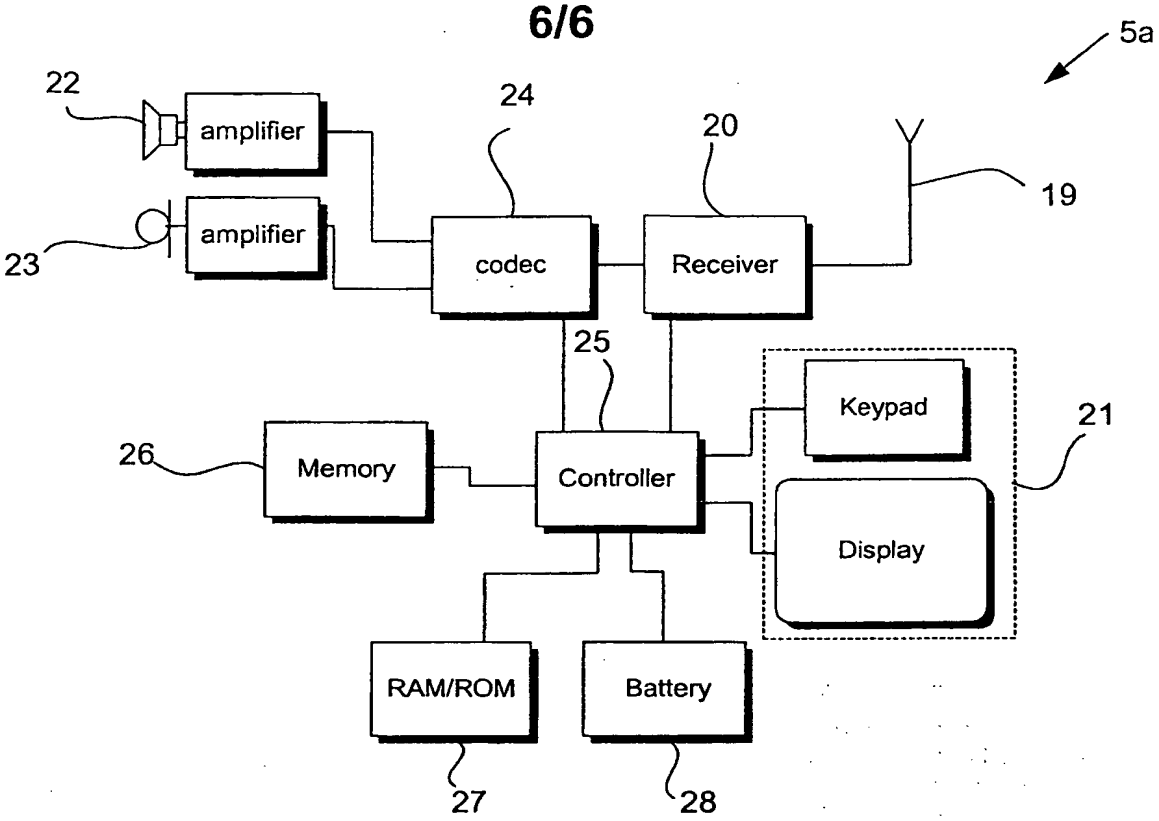

Figure 11

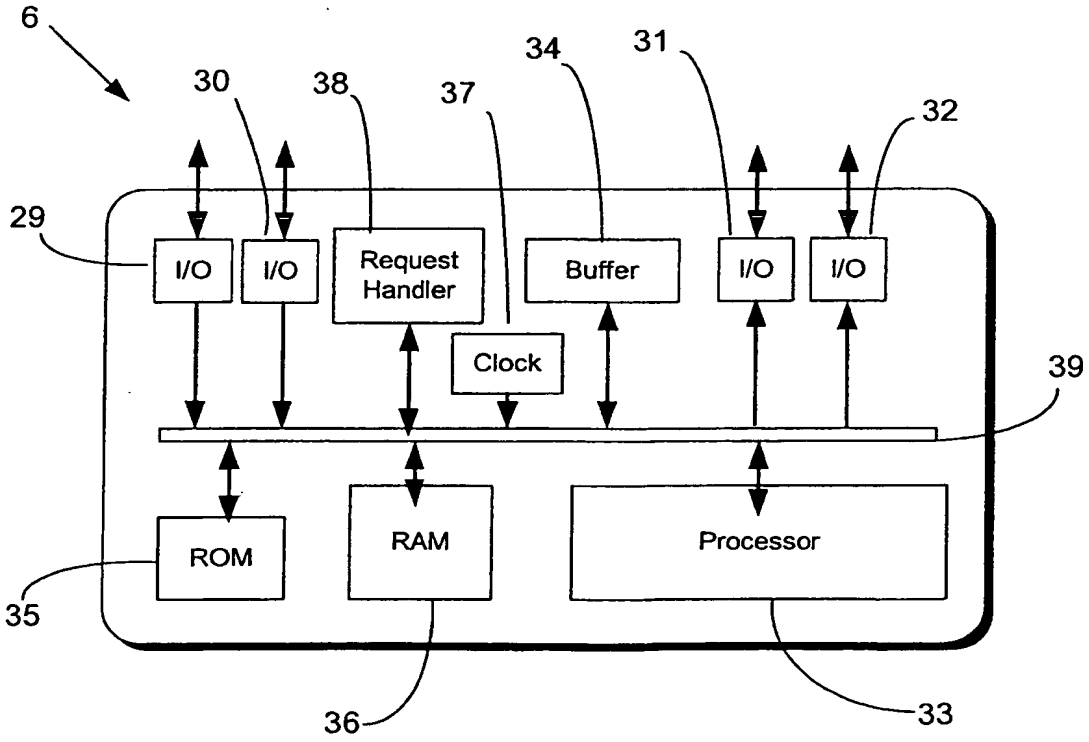

Figure 12

2399719

Transmission of Data with Forward Error Correction Information

The invention relates to the transmission of data and associated forward error correction information to one or more receiving devices and is particularly suitable for, but not limited to, multicasting or broadcasting audio, video or other data to portable receiving devices.

In a communication system, a content provider may send data, such as audio, video or multimedia clips, software or other data files, to one or more users. The content divided into a sequence of data packets for transmission to one or more receiving devices. However, packets of data may be lost or become corrupted in transit.

There are a number of techniques for ensuring the reliable reception of data. A first method requires bi-directional communication between the transmitter and receiving device and a suitable communication protocol, such as TCP/IP, so that a receiving device can send an acknowledgement message (ACK) when a data packet is received and successfully decoded. Alternatively, the receiving device may be configured to send a negative acknowledgement message (NACK) if a data packet has not been received or if a received data packet contains errors and cannot be decoded. In this case, the transmitter responds to a NACK message by re-transmitting the relevant data packet to the receiving device.

This method is useful for unicast data delivery, but if data is transmitted to a number of receiving devices, the use of ACK or NACK messages and re-transmission of data packets may lead to traffic congestion, particularly where a plurality of receiving devices require the re-transmission of different data packets. This problem is exacerbated in a system where, if a first receiving device has lost a data packet, the data packet is re-transmitted to all the receiving devices that received the original transmission, regardless of whether or not it is required. In wireless communication systems, this method may result in a significant load on the air interface and, as the demand for the provision of Internet type services in mobile receiving devices rises, the efficient use of air interface bandwidth is an increasingly important consideration.

An alternative technique of ensuring reliable reception of content entails repeating the transmission of the entire data packet sequence. A receiving device that has missed a data packet, or has received a corrupted data packet, can receive the corresponding data packet in the repeated transmission and insert it into its correct position in the sequence. Any copies of data packets that were received in the original transmission are discarded. This method does not require bi-directional communication between the content provider and receiving device, and so is more suitable for multicast and broadcast applications, as well as allowing greater flexibility regarding the types of communication networks and protocols used. However, the re-transmission of the entire data packet sequence without regard to whether it is required by each of the receiving devices needlessly increases the load in the air interface bandwidth and system resources. For example, a single repetition of the data packet sequence decreases the effective bandwidth of the transmission by a factor of 2. Furthermore, a significant proportion of the power consumption in a receiving device arises from the demands of a receiver during data reception. Therefore, this method may be wasteful and undesirable where the receiving device has only limited power available, for example in a mobile telephone powered by a battery.

The third technique for reliable delivery of data is Forward Error Correction (FEC), in which the content provider transmits a set of data packets carrying the content together with an associated set of redundant data packets, which carry recovery information. If the number of transmitted data packets, i.e. the content data packets and the recovery data packets, successfully decoded by a receiving device exceeds a predetermined threshold, the missing content can be reconstructed. The feasibility of a reconstruction is determined by the number of received data packets, regardless of which particular data packets that have been received by the receiving device.

Forward error correction can be implemented using of BCH (Bose, Chandhuri, Hocquenghem) codes. An important sub class of these is Reed Solomon codes that are suitable for use in digital video broadcasting. In general terms, packet level

forward error correction can be implemented using BCH codes by transmitting M recovery data packets after each set of N content data packets. The sequence of content data packets can be reconstructed if at least N of the N+M transmitted packets are received.

In these systems, each of the receiving devices to which the transmission is directed receive the recovery information, regardless of whether or not it is required. Typically, the N+M content data packets and recovery data packets are transmitted in sequence, in the following order: n1, n2, n3, ... nN, m1, m2,...mM, so that the sequence of content data packets n is transmitted before the recovery data packets m. If there are no transmission errors, the transmission of the M recovery data packets wastes network resources, while the unnecessary reception and processing of the M packets in mobile terminal consumes power.

In some cases, it may be possible to strike a balance between the number M of redundant data packets and reliability. The proportion of the transmission dedicated to the recovery information may be determined by the nature of the content. For example, if the content is streaming audio and/or video data, occasional loss of data, such as a small number of missing frames, may be tolerable. If, however, the content is a data file or software, it may be necessary for the file or program to be received to be error-free.

According to the invention there is provided a method of transmitting content to one or more receiving devices comprising: generating recovery data for use in forward error correction of the content; transmitting the content to said receiving devices over a first communication channel; and transmitting the recovery data to one or more of said receiving devices over a second communication channel.

The invention also includes a method of transmitting content to one or more receiving devices comprising: generating recovery data for use in forward error correction of the content; transmitting the content to said receiving devices over a first communication channel; and in response to a request from one or more of said

receiving devices, transmitting the recovery data to said one or more receiving devices over a second communication channel.

In another aspect the invention provides a method of receiving content from a source comprising: receiving one or more content data packets from a first communication channel; receiving recovery data for use in forward error correction of the content data packets from a second communication channel; determining whether the received content data packets contain errors and whether said errors are correctable; and in response to a positive determination, performing forward error correction of the received content data packets using the received recovery data.

The invention also includes corresponding transmitting and receiving apparatus, as will be evident from the claims hereinafter.

The first and second communication channels may be provided by first and second communication networks respectively, i.e. a hybrid network. Where a receiving device has failed to successfully receive the content data due to factors such as poor signal strength, a second communication network may, in some scenarios, provide a receiving device with a stronger signal, increasing the likelihood that a sufficient number of content data packets and recovery data packets for performing a forward error correction procedure will be received.

In such a hybrid network, the first transmission path may be a uni-directional network, such as a terrestrial Digital Video Broadcasting (DVB-T) network and the second transmission path may be bi-directional, such as a Third Generation (3G) network, for transmitting both a message from the user requesting the recovery information and the recovery information itself.

The data recovery packets may be created separately, by different apparatus from that used to produce data content packets.

A communication system can then be configured so that recovery information can be selectively received, e.g. to those receivers that request it or depending on the

type of content. The reliability of a transmission can be guaranteed in accordance with the type of data or by agreement with the user and allows the user to be billed for this service.

According to an embodiment of the invention content data is sent as groups of data packets or datagrams. The content data packet groups may also be transmitted as recurring bursts repeatedly or periodically e.g. with time division multiplexing. The recovery information may be formed for each packet or a group of packets and it may be associated with the corresponding content packets. The recovery information may be transmitted respectively as single packets or as one or more groups of packets repeatedly or as a response to a received request. The content data and recovery data packets preferably comply with e.g. DVB-T standards and they are provided with a standard format header for identifying the type of the packet and associating information.

An embodiment of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a communication system according to a first embodiment of the invention;

Figure 2 depicts a method of transmitting data according to the first embodiment;

Figure 3 is a flowchart of the method of transmitting data depicted in Figure 2;

Figure 4 depicts a method of receiving data according to the first embodiment;

Figure 5 is a flowchart of the method of receiving data depicted in Figure 4;

Figure 6 is a schematic block diagram of a second embodiment of the invention;

Figure 7 is a flowchart of a content data transmission process according to a second embodiment of the invention;

Figure 8 is a flowchart of a data reception process according to the second embodiment;

Figure 9 depicts the transmission of recovery data to receiving devices according to the second embodiment;

Figure 10 depicts the transmission of content and recovery data to a receiving device according to a second embodiment of the invention;

Figure 11 is a block diagram of a receiving device for use with the first or second embodiment; and

Figure 12 is a block diagram of a network element for use with the first or second embodiment.

Figure 1 is a block diagram of a communication system 1 according to a first embodiment of the invention. The communication system comprises a content provider 2 that has access to sources 3, 4 of content, such as audio-visual content, data files or images.

The content is transmitted using IP over DVB-T network, in what is known as an IP Datacasting (IPDC) service, to one or more receiving devices 5a, 5b. The receiving devices 5a, 5b, e.g. mobile telephones, are configured to receive data from at least two different communication channels.

The content data is transmitted to a network element 6, which is a server configured to receive the content data and to generate recovery data for use in forward error correction of the content data. The content data is transmitted to the receiving devices 5a, 5b via a first channel. In this example, the first communication channel is provided by a Digital Video Broadcasting terrestrial (DVB-T) network 7, which includes a transmitter 8. The content is broadcast to all suitable receiving devices 5a, 5b within a cell associated with the first communication network 7.

The recovery data is transmitted to the receiving devices 5a, 5b via a second communication channel provided by a Third Generation (3G) mobile network 9, which includes a transmitter 10.

It should be noted that the communication paths for the content and recovery data are shown in Figure 1 in a simplified form. However, other elements such as further transmitters, network elements or networks may be situated in these communication paths.

The procedure followed by the network element 6 and a receiving device 5a according to the first embodiment will now be described with reference to Figures 2 and 3. Starting at step s3.0, content in the form of a data file 11 is retrieved from content provider 2 (step s3.1). In this example, the data file 11 is in the form of a set of IP datagrams. An encoder within the network element 6 generates two set of data packets as follows. A sequence of content packets D1-D*n* are formed from the content 11 and encapsulated according to the DVB Multi-Protocol Encapsulation (DVB-MPE) profile (step s3.2). A sequence of recovery packets R1-R*m*, which convey recovery information for use in forward error correction of the content packets D1-D*n* are generated from the content 11 based on Reed Solomon codes (step s3.3) and configured to packets that can be transmitted over the second communication network.

The content packets D1-D*n* are and are sent to the receiving devices 5a, 5b over the first communication network 7 (step s3.4), while the recovery packets R1-R*m* are delivered via the second communication network 9 (step s3.5). The procedure is then complete (step s3.6). This is shown schematically in Figure 2.

The transmission steps s3.4, s3.5 may be performed sequentially or in parallel. As the content packets D1-D*n* and recovery packets R1-R*m* are transmitted separately, a user of a receiving device 5a, 5b can elect either to receive both the content and recovery packets D1-D*n*, R1-R*m* or to receive only the content packets D1-D*n*. By doing so, the user is selecting an acceptable quality of service. This choice can be made in terms of a guaranteed quality of service in a subscription agreement between the user and content provider. Alternatively, the user may elect to receive the recovery data by joining an associated multicast group. The delivery mechanism used for transmitting the recovery data packets R1-R*m* then depends on the number of receiving devices 5a, 5b electing to receive it. The recovery data R1-R*m* may be broadcast, multicast or transmitted using a point-to-point delivery mechanism accordingly.

A process for receiving data at a receiving device 5a according to the first embodiment of the invention is shown in Figures 4 and 5. Beginning at step s5.0, the content data D1-D4 and recovery data R are received (steps s5.1, s5.2) from the first and second communication channels in the first and second communication networks 7, 9 respectively.

An error correction module 12 determines whether the content packets D1-D*n* contain errors or whether they have been received successfully (step s5.3). Where there are errors, for example, if one or more content data packets has been lost or corrupted, the error correction module 12 determines whether the combined number *p* of content and recovery packets that have been received is sufficient to allow reconstruction of the remaining content packets (step s5.4). Generally, packet level forward error correction can be performed if the receiving device 5a has successfully received at least *n* of the *(n + m)* transmitted data packets D1-D*n*, R1-R*m*, regardless of which particular data packets have been received. If this condition is met, the recovery data is used to reconstruct the missing content packets (step s5.5). If the number *p* of received data packets is below this threshold *n*, the receiving device 5a can request re-transmission of the data or in another embodiment of the invention to retransmission of the recovery data(step s5.6). Alternatively, if the number of errors are at a tolerable level, the receiving device 5a may simply drop the corrupted data.

If the receiving device 5a has obtained the full series of content data packets D1-D*n*, either by receiving the series without any errors or by partially reconstructing one or more content data packets D1-D*n*, the content data packets are de-encapsulated (step s5.7) by a decoder 13, to produce a copy of the original data file 11'. The data reception process is then complete (step s5.8).

In the first embodiment of the invention described above, the transmission of content data is always accompanied by the transmission of its associated recovery data R. However, if all the receiving devices 5a, 5b successfully receive the content data, the recovery data is not needed. In a second embodiment of the invention,

the recovery data is transmitted only when required by a receiving device 5a, conserving receiver power and air interface bandwidth. The process of transmitting and receiving data according to the second embodiment of the invention will now be described, with reference to Figures 6, 7, 8 and 9.

In the second embodiment another encoder is provided for making the recovery packets R. This encoder then either sends the packets to a network operator or holds them until requested. A buffer is provided in the network where recovery packets R are held until requested. Referring to Figure 6, the second embodiment is similar to the first embodiment of Figure 1, with the addition of an encoder/buffer 16 for producing the R packets, associated with a network operator 17.

Referring to Figure 7, in operation, beginning at step s7.0, the network element 6 receives content to be transmitted to the receiving devices 5a, 5b from the content provider 2 or data source (step s7.1) and generates a series of data packets D1-D*n* (step s7.2). A series of recovery packets R1-R*m* is generated separately by encoder/buffer 16 e.g. using Reed Solomon codes and stored in the network (step s6.3). In this example, the encoder 16 is associated with a network operator 17 and the recovery packets may be stored by the network operator 17 until needed. The content packets are transmitted to the receiving devices 5a, 5b (step s7.4) over a first communication network 7, via transmitter 8 using IP over DVB-T, completing the content transmission process (step s7.5).

Starting at step s8.0 in Figure 8, receiving device 5a receives a series of content data packets (step s8.1) and determines whether it contains errors, such as missing or corrupted packets (step s8.2). If errors are present in the received content data, the receiving device 5a sends a message to the operator of network operator 17, requesting the recovery packets R1-R*m* (step s8.3).

Beginning at step s9.0 in Figure 9, having received and stored the recovery packets R1-R*m*, the network operator 17 receives the request from the receiving device 5a (step s9.1). The network operator 17 then allows a limited period of time *t1* for the reception of further requests from other receiving devices 5b (step s9.2). After the

expiry of time period *t1*, the stored recovery packets R1-R*m* are retrieved and transmitted to the one or more receiving devices 5a, 5b that have submitted requests (step s9.3). Where more than one receiving device 5a, 5b has requested the recovery packets R1-R*m*, the network operator 17 transmits the recovery packets R1-R*m* using a multicast or, if necessary, broadcast delivery mechanism over the second communication network 9, via transmitter 10. Alternatively, the network operator 17 may be configured to respond to each request by transmitting the recovery packets R1-R*m* using a point-to-point delivery mechanism. The transmission of the recovery packets is then complete (step s9.4). Furthermore, based on the number of requests, the network operator 17 may resend the whole broadcast transmission through the first communication network.

On reception of the recovery data packets R1-R*m* (step s8.4), the receiving device 5a determines whether it has received a sufficient number *n* of transmitted data packets D1-D4, R to permit reconstruction of the remaining content data packets (step 8.5). If this condition is not met, the receiving device 5a sends a further request to the network operator 17, requesting a repeat transmission of the recovery data R (step s8.3). The procedure shown in Figure 9 is then repeated by the network operator 17.

The receiving device 5a repeats steps s8.3, s8.4 and s8.5 until it has received *n* or more of the transmitted data packets D1-D*n*, R before correcting errors in the content data packets D1-D*n* using the recovery information R (step s8.6). The content data packets D1-D*n* are then decoded (step s8.7), completing the reception process (step s8.8).

An example of a situation in which a plurality of receiving devices 5a, 5b may have different data reception quality is shown in Figure 9. In this figure, a first receiving device 5a is located at the edge of a cell C1 in the first communication network 7, while a second receiving device 5b is located well within the boundary of cell C1. When the transmitter 8 transmits the content packets D1-D*n*, the signal received by the first receiving device 5a is likely to be weaker than that received by the second

receiving device 5b and, therefore, the series of content data packets D1-D*n* received by the first receiving device 5a is more likely to contain errors. It is therefore more likely that the first receiving device 5a will require the recovery data R, which is transmitted over the second communication network 9 by transmitter 10. In this example, the second communication network 9 is associated with a different set of cells C2 and so the reception quality for the recovery packets R1-R*m* may exceed that of the content packets D1-D*n*, increasing the likelihood that a sufficient number of transmitted data packets D1-D*n*, R1-R*m* will be received by the first receiving device 5a for performing forward error correction.

The receiving device 5a may be a mobile telephone, as shown in Figure 11, which receives incoming data using one or more antennae 19 or several antennas and one or more receivers 20. For example, multiple antennae 19 and receivers 20 would be needed where the first and second communication network utilise different radio technologies. The receiving device further comprises a user interface 21, with a keypad and display, a speaker 22, a microphone 23 and codec 24. The operation of the mobile telephone 5a is controlled by a controller 25, which has associated memories 26, 27. The mobile telephone 5a is powered by a battery 28. As the reception of data consumes a large proportion of the battery power, the second embodiment of the invention, in which the recovery data R is transmitted only on request, is particularly advantageous for such a device. The method of providing redundancy packets over the other communication network makes it possible to have terminals, which do not have any error correction implemented (low end terminals). Subscribers having 'high end' terminals could have as extra benefit the possibility to get recovery packets from second network.

An example of a suitable network element 6 is shown in Figure 12, which may be implemented on a standard industrial computer. The device 2 comprises input/output interfaces 29, 30, 31, 32 for communicating with the data sources 3, 4 and the networks 7, 9. The operation of the content provider 2 is monitored and controlled by a processor 33, including the generation of recovery data and data encapsulation processes. A buffer 34 is also included for storing content and recovery data as required, memory facilities 35, 36 and a clock 37. A request

handler 38 handles requests for content data D1-D*n* and, depending on the implementation of the invention, requests for recovery data R1-R*m*. The various components communicate with one another via a data bus 39. The functionality can be split to different network elements. For example the generation of recovery packets can be done in one place and the decision of whether to send those immediately or at request can be done elsewhere.

The invention has been described by way of example and is not limited by the specific details of the first and second embodiments. In particular, the first and second communication channels may be provided by a single network instead of a hybrid network, so that, while logical delivery pipes for the content data D and recovery data R are separate, they are not physically different.

The recovery data is not necessarily generated using Reed Solomon codes, in other embodiments of the invention other type of codes are also applicable. The buffer can be at network element in other embodiments of the invention.

The invention may be used to transmit data using delivery mechanisms other than IP datacasting and protocol profiles other than DVB MPE. The invention may be applied to delivery of data to one or more receiving devices 5a, 5b using a point-to-point mechanism, multicasting or broadcasting.

It is not necessary for the receiving devices 5a, 5b to be mobile telephones as the invention is applicable to other receiving devices, such as personal computers and personal digital assistants, whether fixed or mobile. Where a receiving device is fixed, its location within a cell of the first communication network, for example its proximity to the edge of the cell, may determine whether or not the recovery data is transmitted to it in a method according to the first embodiment of the invention.

The communication system need not comprise a wireless communication network 6, 8. While the embodiments described included a DVB-T network, the invention may be used with other types of networks, digital and non-digital, including other digital broadcast networks such as DVB-S (satellite), DVB-C (cable), Integrated Services

Digital Broadcasting (ISDB), ATSC Digital Television or Digital Audio Broadcasting (DAB) and, potentially, forthcoming DVB-MHP (Multimedia Home Platform) networks, 3G broadcast network MBMS can be regarded as first communication network.

It is not necessary for the second communication network to be a 3G mobile network. Both the first and second communication networks may be uni-directional or bi-directional.

The first and second communication networks can be same network with logical separation of transmitting content data packets and recovery data packets. For example broadcast mode of a 3G network can be used for the content data packets and the recovery data packets can be delivered using same base station but in unicast or multicast mode. Alternatively IP over DVB-T or another DVB mode could be used for delivering content data packets and then a different logical channel in the same IP over DVB-T base station could be used for delivering recovery data packets.

The first and second communication networks can be both based on same technology but the content data packets are sent over different base station or stations than recovery data packets. Example in 3G would be the usage of overlay macrocell for data packets and underlay microcells for recovery data packets or vice versa. In IP over DVB-T the content data packets could be sent using different physical transport than recovery data packets.

Claims

1. A method of transmitting content to one or more receiving devices comprising:

generating recovery data for use in forward error correction of the content;

transmitting the content to said receiving devices over a first communication channel; and

transmitting the recovery data to one or more of said receiving devices over a second communication channel.

2. A method of transmitting content to one or more receiving devices comprising:

generating recovery data for use in forward error correction of the content;

transmitting the content to said receiving devices over a first communication channel; and

in response to a request from one or more of said receiving devices, transmitting the recovery data to said one or more receiving devices over a second communication channel.

3. A method of receiving content from a source comprising:

receiving one or more content data packets from a first communication channel;

receiving recovery data for use in forward error correction of the content data packets from a second communication channel;

determining whether the received content data packets contain errors and whether said errors are correctable; and

in response to a positive determination, performing forward error correction of the received content data packets using the received recovery data.

4. A method of receiving content from a source comprising:

receiving one or more content data packets from a first communication channel;

determining whether the received content data packets contain errors and whether said errors are correctable; and

in response to a positive determination, sending a request for the recovery data to the source, receiving recovery data from a second communication channel and using said received recovery data for performing forward error correction of the content data packets.

5. A method according to any one of the preceding claims, wherein the first communication channel is provided by a first communication network and the second communication channel is provided by a second communication network.

6. A method according to any one of the claims 1 to 4, wherein the first communication channel and the second communication channel are logical channels in the first communication network.

7. A method according to any one of the claims 1 to 4, wherein the first communication channel and the second communication channel are logical channels in the second communication network.

8. A method according to claim 5, 6 or 7, wherein the first communication network is uni-directional.

9. An apparatus for transmitting content to one or more receiving devices comprising:

a processor configured to generate recovery data for use in forward error correction of the content; and

a transmitter configuration operable to transmit the content to said receiving devices over a first communication channel and to transmit the recovery data to one or more of said receiving devices over a second communication channel.

10. An apparatus according to claim 9, further comprising:

an input interface for receiving requests from said one or more receiving devices;

wherein the transmitter is operable to transmit the recovery data over the second communication channel in response to the reception of a request.

11. An apparatus according to claim 9 or 10, further configured to transmit the content over a first communication network and to transmit the recovery data over a second communication network.

12. An apparatus according to claim 11 including means for providing said content in packets for transmission through the first network, and separate means for providing said recovery data in packets for transmission through the second network.

13. An apparatus for receiving content from a source comprising:

a receiver operable to receive one or more content data packets from a first communication channel and to receive recovery data for use in forward error correction of the content data packets from a second communication channel; and

a processor configured to determine whether the content data packets contain errors and whether said errors are correctable, and, in response to a positive determination, to perform forward error correction using said recovery data.

14. An apparatus according to claim 13, wherein, in response to a positive determination, the processor is configured to send a request for the recovery data

a receiver operable to receive one or more content data packets from a first communication channel; and

a processor configured to determine whether the content data packets contain errors and whether said errors are correctable, and, in response to a positive determination;

wherein, in response to a positive determination, the processor is configured to send a request for recovery data to the source and, in response to the reception of the recovery data, to perform forward error correction using said recovery data.

15. An apparatus according to any one of claims 11 to 14, wherein the first communication channel is provided by a first communication network and the second communication channel is provided by a second communication network.

16. An apparatus according to any of claims 11 to 15, comprising a mobile telephone handset.

17. A communication system comprising an apparatus according to any one of claims 11 to 16.

18. A method substantially as hereinbefore described with reference to the accompanying drawings.

19. An apparatus for transmitting content substantially as hereinbefore described with reference to the accompanying drawings.

20. An apparatus for receiving content substantially as hereinbefore described with reference to the accompanying drawings.

21. A communication system substantially as hereinbefore described with reference to the accompanying drawings.

The Patent Office
PATENTS • DESIGNS • COPYRIGHT • TRADE MARKS
INVESTOR IN PEOPLE

Application No: GB 0306184.3
Claims searched: 1 to 21

Examiner: Ken Long
Date of search: 12 June 2003

Patents Act 1977 : Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance	
X	1, 3, 6-9, 13, 16, and 17	WO 02/43314 A1	NORTEL (page 11 line 8 to page 12 line 6)
X	1, 3, 6-9, 13, 16, and 17	WO 01/65760 A1	NOKIA (page 18 lines 10-34)
X	1, 3, 6-9, 13, 16, and 17	EP 0999669 A1	NORTEL (column 3 line 46 to column 4 line 8)
X	1, 3, 6-9, 13, 16, and 17	US 6484287 B1	ALCATEL (column 1 lines 10-24 and column 2 lines 10-34)
A	None	WO 00/76113 A1	MICROSOFT (page 1 lines 9-11 and page 4 lines 15-18)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[V]:

None

Worldwide search of patent documents classified in the following areas of the IPC[7]:

H04L

The following online and other databases have been used in the preparation of this search report:

ONLINE : EPODOC, WPI, JAPIO